a scrambling flight and disappearing over the top. The flow continued in profusion till afternoon of the next day, then became sparse and irregular. To estimate the total number of butterflies, the number passing through an area 30 m high and 30 m in width were counted at 1140 hrs on 28 May, by using a chronometer. In two minutes, 102 butterflies passed through the segment. The butterflies passing outside this segment were not counted. By a crude estimate, considering that a very negligible portion was flying through the segment, at least 75,000 to 80,000 butterflies passed the camp site in the day and a half. Despite such abundance of cabbage white butterflies and presence of black swift *Apus apus*, hobby *Falco subbuteo*, kestrel *Falco tinnunculus*, predation was not noticed. This butterfly is considered as distasteful.

There are a few reports on migration of *Pieris brassicae*. Hingston (vide Williams 1930) has described the on (*Hydrilla* sp.) was kept in the aquarium to provide substratum for the waterbugs. The snail *Lymnaea luteola* of different size classes were supplied to the bugs as food regularly. The female waterbugs deposited eggs on the back of the males within a few days. Four such egg-bearing males were kept separately, in a plastic container of two litre capacity, at 20°C, 25°C, 30°C, constant temperature grades maintained in different chambers of a BOD incubator and at room temperature (19°C-35°C). The newly hatched nymphs were maintained carefully with the supply of preferred sized *L. luteola* daily, as their food. The experiments were terminated when all the waterbugs (nymphs) metamorphosed into adults. Throughout the experi

Another summer season (May-June 1989) was spent in the same area, but the migration was not noticed. Specimens of *P. brassicae* were collected and added to the BNHS collection. The identification was confirmed by Mr. Naresh Chaturvedi. Thanks are also due to him for help with references.

Similar other records of migration of this species will be worth placing on record so as to eventually plot a definite route/pattern of migration.

October 12, 1989 NITIN JAMDAR

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33. INFLUENCE OF TEMPERATURE ON SEX DETERMINATION OF THE WATERBUG *SPHAERODEMA RUSTICUM* FAB.

Though sex determination is a purely genetic mechanism, the influence of environmental factors on the same cannot be ruled out (Conover and Heins 1987, Conover and Kynard 1981, Charnov and ull 1977). Of the environmental factors, temperature seems to be the most important one. It is reported that the sex ratio in a few invertebrates, fishes, alligators and turtles varied widely in response to temperature regime (Conover and Heins 1987, Conover and Kynard 1981, Bull and Vogt 1979, Charnov and Bull 1977). Investigation on this aspect in insects is necessary. We have studied it in the waterbug *Sphaerodema rusticum* Fab. and the results are given below.

A good number of adult waterbugs *S. rusticum* were collected from a pond located in the Ballygunge Science College campus, Calcutta University, Calcutta, and kept in an aquarium measuring 60 x 25 x 45 cm, filled with pond water up to 30 cm height. A considerable amount of aquatic vegetation (*Hydrilla* sp.) was kept in the aquarium to provide substratum for the waterbugs. The snail *Lymnaea luteola* of different size classes were supplied to the bugs as food regularly. The female waterbugs deposited eggs on the back of the males within a few days. Four such egg-bearing males were kept separately, in a plastic container of two litre capacity, at 20°C, 25°C, 30°C, constant temperature grades maintained in different chambers of a BOD incubator and at room temperature (19°C-35°C). The newly hatched nymphs were maintained carefully with the supply of preferred sized *L. luteola* daily, as their food. The experiments were terminated when all the waterbugs (nymphs) metamorphosed into adults. Throughout the experiment strict hygienic conditions were maintained by changing the pond water, by removing the dead snails and waterbugs, if any, by removing the empty shells of *L. luteola* and by changing the plant materials regularly.

The number of newly hatched nymphs, the number of adult waterbugs metamorphosed out of these nymphs, the number of male and female waterbugs in respect of the selected 4 clutches against four different temperature grades have been shown in Table 1. It is evident that the sex ratio at 30°C constant temperature was 1 : 1 (M:F) while at 25°C and 20°C the same was 1 : 2 and 1 : 5.5 respectively.

TABLE 1
EXPERIMENTAL DATA SHOWING SEX RATIO OF *S. rusticum* MAINTAINED AT DIFFERENT TEMPERATURES

Temperature (° C)	Clutch no.	No. of newly hatched nymphs	No. of nymphs metamorphosed into adults	No. of males	No. of females	Sex ratio (M:F)
	1	50	6	0	6	
	2	30	4	1	3	
20	3	12	1	0	1	1:5.5
	4	8	2	1	1	
	Total	100	13	2	11	
	1	50	10	4	6	
	2	25	7	25		
25	3	10	3	1	2	1:2
	4	12	4	1	3	
	Total	97	24	8	16	
	1	40	7	4	3	
	2	30	6	3	3	
30	3	25	7	3	4	1:1
	4	30	8	3	5	
	Total	125	28	13	15	
	1	50	17	8	9	
Room temp.	2	40	11	5	6	1:1
(19-35)	3	30	7	3	4	
	4	25	6	4	2	
	Total	145	41	20	21	

It is established that the metamorphosis and attainment of sexual maturity in animals, especially insects, are regulated by hormones. It is likely that the synthesis of hormone is highly temperature dependent. The quantitative study of the hormones in these insects reared at these temperatures would enable us to throw some light on the role of temperature on the determination of sex in insects. It is apparent that the percentage of females would gradually increase with the lowering of temperature from 30°C to 20 °C.

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S.K . RAUT
December 1, 1989 J.K. ROY

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34. OCCURRENCE OF BIVALVED GASTROPODS IN THE WEST COAST OF INDIA, ARABIAN SEA

The bivalved gastropods are noteworthy for their anomalous shells. Ever since the discovery of the first living representative of the bivalved gastropods, *Berthelinia limax* from Bison Seto, Inland Sea of Japan by Kawaguti and Baba 1959, establishing its true identity as sacoglossan opisthobranch, many discoveries and descriptions of bivalved gestropods have been published from different parts of the world (Table 1). From Indian